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THE Agricultural History Society aims to promote interest, study, and research in the history of agriculture. Its quarterly journal is being developed as a medium for the publication of research and documents and as a clearing house for information of interest and value to workers in this field.

At the present time the Society's outstanding need is funds with which to increase the size of the journal. Members of the Society can help materially by remitting their dues and making active efforts to secure new members.

The Society is constantly receiving calls, chiefly from libraries, for copies of the early issues of the journal. The Society's supply of the first number of the first volume is exhausted. Anyone having a copy (or extra copies) of this number will be doing the Society a great service by sending it to the Secretary or letting him know of its availability.

Members can also help fulfill the purposes of the Society by reporting news of research and other activities relating to agricultural history, the location of important documents and papers pertaining to this field, and making suggestions which will help extend the influence and the scope of the work of the Society.

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The Agricultural History Society was founded in Washington, D. C. in 1919 and incorporated in 1924. At present the Society has two hundred and sixty members in the United States and foreign countries. An annual meeting is held in Washington in the spring or early summer. Through an affiliation agreement, the Society holds a session and dinner in connection with the annual meeting of the American Historical Association.

Three volumes of AGRICULTURAL HISTORY PAPERS have been published with the assistance of the American Historical Association, and distributed separately by the Society.

In 1927 the Society began the publication of *Agricultural History*, a quarterly journal. Two numbers were published during the first year. Plans are being made for quarterly issues in 1928.

Correspondence concerning contributions, manuscripts, books for review, and membership, should be sent to the Editor.

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THE CONTINENTAL CONGRESS AND AGRICULTURAL SUPPLIES

BY EDMUND C. BURNETT¹

When John Adams in the early years of the nineteenth century sat down to write his autobiography, his career as a statesman ended, that of a sage (presumably) about to begin, he went nosing through the *Journals* of the Continental Congress to refresh his recollections and to put his finger on those things which he might set down to his credit. In these excursions into an important phase of his career he made many comments on men and measures, including himself and his own; and, while his memory was remarkably retentive and reasonably accurate, it is abundantly evident that his recollections had been modified both in color and in tone by the hand of time and that his judgment has not infrequently been warped by his personal idiosyncrasies. It happens therefore that now and again other facts, not then before him or remembered by him, show that comments made and credits claimed were unsubstantially founded.

Running thus his finger down the pages of the *Journals* he came to a group of resolutions under March 21, 1776, and he paused to write down in his notes: "There are three resolutions which I claim. These resolutions I introduced and supported, not only for their intrinsic utility, which I thought would be very con-

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siderable, but because they held up to the view of the nation the air of independence." The first of these resolutions proposed that it be recommended to the authorities in the several colonies "that they exert their utmost endeavors to promote the culture of hemp, flax, and cotton, and the growth of wool in these united colonies." The second was a recommendation to the colonies "that they take the earliest measures for erecting and establishing, in each and every colony a society for the improvement of agriculture, arts, manufactures, and commerce, and to maintain a correspondence between such societies, that the rich and numerous natural advantages of this country, for supporting its inhabitants, may not be neglected." The third resolution pertained to the encouragement of certain manufactures and therefore is not particularly pertinent to this study.

There need be no hesitancy in giving to Mr. Adams whatever credit pertains to the introduction of these resolves; for Richard Smith, in his diary of the proceedings of Congress, definitely ascribes these resolutions to Mr. Adams, and adds: "a Clause was erased for a standing committee of Congress to correspond with and assist these Societies." By the failure of this one little clause therefore we narrowly escaped the establishment of a department of agriculture even before there was any declaration of independence. The resolutions were, however, published, but whether they ultimately bore fruit and how many fold, deponent sayeth not. For aught I know these fertile ideas of John Adams have found their only home in that Nirvana where dwell so many other glorious visions and brilliant and noble ideas born of the enthusiasm and high purpose of those early days of the Revolution. Not all such visions of course dwell there. Many of them, in their premature efforts to soar into political, financial, economic, or social skies soon plunged to earth with broken wings. At all events, the time was close at hand when the Continental Congress and all associated with them in authority were to become so deeply, so painfully, engrossed in the strenuous struggle to obtain from week to week or even from day to day enough of the actual products of the farm, wherever and however they might be found, to appease the hunger of a sometimes mutinous army, that visions

and plans of agricultural development which peered very far beyond the horizon of speedy returns were likely to be cast aside—I won't say into outer darkness, for Congress had almost at all times right at its front door and sometimes within doors about all the wailing and gnashing of teeth that its soul could well endure.

I said a moment ago that we narrowly escaped—perhaps I should have said, we almost obtained, a department of agriculture even in the early part of 1776. But I am not so sure of it. Not every one that saith "Beans, beans!" entereth into the kingdom of agriculture, and not every resolve of Congress however strong the phrase or fervent the appeal bore fruit even a single fold. The Continental Congress was largely limited in its legislative and executive powers to recommendations, requisitions, earnest pleas and supplications to the states, and too often it was the case that, when a state was asked what steps had been taken to carry out the recommendations of Congress, the reply was in effect: "Gentlemen, we have your resolve, which we have kept carefully laid away in a napkin." In short, the Continental Congress, however earnestly it might desire to have its resolves enforced, had but an exceedingly meagre supply of teeth that it could put into any measure. In any estimate of the doings of Congress this fact must not for a moment be lost sight of.

What I said a moment ago respecting the everlasting pressure upon Congress to find supplies for the army and find them quickly, may be regarded as the key to the whole history of its proceedings with regard to agricultural supplies. The important thing, the necessary thing, was to obtain them somehow, and the ways and means would depend on where they were wanted and where they might be found, upon the particular exigency and the degree of urgency. Not that Congress decried all method. On the contrary, there was often an excess of method. It is not altogether apt to say there was method in its madness, but there were times when one is prone to declare there was madness in its methods. There are some excellent exhibits of this nature in the realm of agricultural supplies; but the best example that now comes to mind is a measure for the organization and conduct of the Treasury Department, which Congress labored over and patted and

polished for a year or more, only to be informed by the men who were appointed to administer it that it was absolutely unworkable. The elaborate pieces of legislative machinery which Congress every now and then devised for the conduct of its departments of supply had for their main purpose the acquisition of the necessary supplies, and secondly for protecting itself and the public from extravagance and fraud, and from many lesser ills as well, in other words, to stop leaks. And, be it said, these measures often appear to be as leak-proof as some barrels do—until you put water in them. I have often been thrilled by the fertility of imagination of the shrewd individuals who drew the measures. As a matter of fact I do not recall that a single one of these pieces of regulation ever turned out to be even passably leak-proof; but really one of the serious troubles with the supply barrel after one of those tight-cooperage committees got through with it was that the ways of getting supplies into the barrel were sometimes made so devious and uncertain that the barrel was likely to remain all but empty. And yet there was one thing that these same zealous brethren almost never failed to do: They were almost certain to leave an auger or two handy, which those other zealous individuals, with eyes single to the main chance, might easily use, if there really was anything in the barrel, for boring a hole in it and filling their sacks. In other words, the measure often provided the means of its own undoing; and the officers in the case were so hedged about by devices to prevent maladministration that oftentimes they were scarcely able to administer the measure at all.

I am speaking now particularly of the middle period of the war, after Congress and the country had undergone many sore trials and tribulations, had experienced failures in the field of arms, disappointments equally great and almost as bitter in the domain of finance, and convulsive wrerings wrought by confusion and worse in the department of supply. These hard-wrought plans came after there had been much anxious searching of the heart and deep anguish of spirit. The beginnings of organization were for the most part very simple. Indeed much of this business of supplies during the first two years of the war was carried on by a

rather direct method; that is, through specific direction of Congress to a committee to act or to report upon ways and means, or similarly specific directions to an officer of the supply department. In the earlier years committees of its own body were the vehicles through which the great bulk of executive and administrative business was carried on, and only very slowly and reluctantly did Congress part with this prerogative of not merely control but of direct action. Nevertheless the creation of a department of supply was one of the earliest steps taken by Congress in the matter of planning to carry on the contest.

First things are often given a degree of prominence that their importance does not warrant, and I do not know that there is any special significance in the first act of Congress in the matter of supplies for the army, except that it is similar to hundreds of other acts that followed it. One of the earliest acts of a military sort was a request to Connecticut, May 31, 1775, to send troops to Crown Point and Ticonderoga, and in the same resolve is a request to the convention of New York to furnish these troops with provisions and other necessary stores. This appears to have been the first step in the business of supplies. The second was like it. On June 9 this same convention was requested to convey to Providence, Rhode Island, or to some port in Massachusetts, 5000 barrels of flour for the use of the army before Boston, and the committees of correspondence of Rhode Island and Massachusetts were asked to receive the flour and convey it to the army or to places of security. Such were the beginnings, before there was any department of supply. On June 15 George Washington was chosen to be commander of all the forces raised and to be raised for the defense of American liberty, and on the following day, as one of the items in the further organization of the army, it was resolved, "That there be one commissary general of stores and provisions, and that his pay be eighty dollars per month." On July 19 Joseph Trumbull of Connecticut was chosen for this post. He was the son of Jonathan Trumbull, governor of Connecticut throughout the period of the war, and was elder brother to John Trumbull, who is best known for his paintings, the Declaration of Independence and the Surrender of

Cornwallis. There was another brother, Jonathan, jr., who was for some time paymaster-general. These were not quite all the Trumbulls, but there was a time when all four of these were in the public eye, sometimes the centre of troubled waters, and there is occasional confusion of them one with another.

The business of the commissary-general was of course with the main army under General Washington. But, as has already been mentioned, there were forces gathering at Crown Point and Ticonderoga, and Congress deemed it needful—the New York delegates evidently deemed it especially desirable—that a distinct commissary for that department should be appointed. For that post Walter Livingston, brother-in-law to James Duane, one of the New York delegates and probably the keenest politician who ever sat in the Continental Congress, was chosen, with the qualifying clause, “during the present campaign.” This election preceded that of Trumbull by two days, although about a month subsequent, it will be remembered, to the creation of the office of commissary-general. Later there were other deputy commissary-generals appointed for particular regions (Virginia, for instance), but I mention this appointment of Walter Livingston specifically because the creation of this office of deputy commissary-general and the appointment of Livingston was in fact, symptomatic of the jealousy that already existed between the New Englanders and the New Yorkers, and its effect was to foment still further the discord between those two groups. On the one hand, we find these antagonisms leading direct to the displacement of Schuyler from the command in New York and the substitution of Gates just in time to win plaudits for the victory over Burgoyne; and, on the other hand, to the notorious Conway Cabal, which aimed to supplant Washington with Gates.

But there were other results more directly connected with the business of supplies. One of the questions that presently arose was, so to speak, whether the dog was to have control of his own tail or was to be wagged or to be otherwise bedeviled thereby. The controversy on this score between Trumbull and Livingston, and more particularly between their respective friends, attained such large proportions and became so bitter as seriously to in-

volve the whole business. Congress eventually (July 9, 1776) passed a resolve that the commissary-general had full power to supply both armies, to employ and appoint such persons under him as he judged expedient, and even to dismiss any deputy commissary. In spite of this resolution Livingston persisted for some time in carrying on in his own way, but finally (September) resigned, apparently to forestall his dismissal.

I have said that the beginnings were largely without organization or definite plan. In the earlier days of the Revolution one will usually look in vain for any definition of the functions and bounds of any office. In the course of time Congress did undertake to do that very thing and often did it with a thoroughness that was all but paralyzing. Preceding this stage there would be resolves upon specific questions as they arose, until finally there would be built up a body of regulations, complex and often conflicting, and then, when confusion became worse confounded, Congress would set about the task of framing a regulatory act.

It was so with the commissary department. It was merely understood at the outset that the business of the commissary-general was to provide the army with necessary supplies. Informed by the commander-in-chief or otherwise what supplies would be wanted and where, he simply went into the market, he and his appointed agents, and purchased them where they could find them. As the business agent of Congress the commissary-general was supposed to make the best bargain he could for his employer.

Questions of many sorts were of course constantly arising which must be referred to Congress for decision. All the while Congress would be deciding for the commissary-general many questions which had not been referred to that body by him, and would be giving orders to him, or setting committees upon specific tasks, as was its precious prerogative. If certain necessary supplies were lacking in the region where the army might be located, it was usually necessary to obtain authority not only from Congress but from the states from which it was desired to obtain the supplies. The states might have embargoes (they often did) upon the exportation of certain commodities, such as flour, and

the intercession of Congress and even other forms of appeal might be necessary in order to obtain them.

I am speaking in very general terms, for the reason that the things done were so multitudinous in number and so varied in character that an attempt to classify them and put them into any sort of system would be like any other task of bringing order out of chaos and, besides, would lead us far beyond our prescribed limits of space and time. Almost every article of consumption has its own story. There is one story of flour and grain (and it is a large and most important one), another story of beef and cattle, another of pork, another of hides, another of forage, and many lesser stories, but essential nevertheless to a comprehension of the history of the means by which the army of men and beasts were fed. There was the problem of clothing of course, but only to a limited extent was the clothing derived from American agriculture. Hides, which I have just mentioned, were not, I believe, at any time an article of diet during the Revolution, although in other wars they have been used for that purpose on occasion as a last resort. As the source of shoes, one of the most necessary articles of clothing for the soldier, hides hold an important place in the war for independence. It became necessary in time that a special commissary should be assigned to that business, and numerous regulations were adopted for the preservation of hides and their proper tanning into leather. It was even proposed in October, 1775, that the inhabitants be encouraged to wear leather waistcoats and breeches and that the members of Congress should set the example. But that was in the days when clothing was scarce and leather, particularly deer skins, appeared to be abundant.

The practice was early adopted of laying up provisions in magazines established at places presumed to be convenient to the army and at the same time in no great danger from the enemy, although there were occasions when these hordes had hurriedly to be removed, as there were also occasions when live stock was likewise hurriedly driven, if possible, out of reach of the enemy. Magazines of provisions would of course be made up of such articles and in such condition as permitted of preservation in

that way. Meats must of course be cured. Pork was preserved in brine or salted down. Flour might be preserved indefinitely under proper conditions, but proper conditions were sometimes absent. In the summer of 1777, for instance, to take an example wholly at random, word came to Congress that a quantity of flour was in danger of spoiling, and orders were at once issued that this flour be baked into biscuits. In one case the secret committee was instructed to contract with bakers for the purpose; in another case the commissary-general was ordered to have it done. Early in his career as commissary-general Trumbull proposed that it would save money if he might have hogs and cattle driven to the locality where the army was encamped and there slaughter them and put away the meat. The order that this should be done was presently sent out.

Here is a fairly good illustration of the way in which many things connected with the supply business were done. Perhaps salt does not properly belong in the category of agricultural supplies, but, as Job reminds us, "Can that which is unsavory be eaten without salt?" Commissary-General Trumbull wished to know whether he might have authority to import salt for the purpose of preserving the meats which he had been ordered to kill and lay up in magazines. For, be it understood, the salt problem in those days was only a little less serious than the powder problem.

"I mentioned the affair of salt to the President," William Williams, delegate from Connecticut (he was a brother-in-law of Trumbull) wrote to Trumbull September 7, 1776. "He says he has laid your and other letters before Congress, and can give no orders which they dont give, but thinks as you must find provisions you most certainly may and ought to find means to preserve it." On September 25, Congress gave the desired authority to Trumbull: "That the commissary general be directed to procure such quantities of salt, and to buy, cure and lay up, in proper places, such quantities of provisions as he shall judge necessary for the next campaign." The authority seems ample enough, as it also seems to be based securely on common sense; and yet Williams wrote to Trumbull a few days afterward that the resolve was by no means obtained without opposition.

Here is another little episode of about the same time. This same William Williams, who, judged from his letters, was one of the sourest and most morose Puritans ever sent to Congress, wrote to Trumbull September 26, 1776: "They [that is, Congress] have alarming accounts from the northern army that the sick have nothing but bread and meat, not so much as Indian meal nor any kind of vegetable etc. and have sent a committee of Mr. Stockton and Clymer to enquire into all the circumstances of that army in order to make them as comfortable as possible." A few days later he wrote: "Have nothing lately of the scolding about vegetables." Then he added, alluding apparently to a similar trouble in a group of Pennsylvania militia: "This militia are got back to their dens, and pampered their guts, and are perhaps more easie."

On October 9, Congress further empowered Trumbull to import salt on the account and at the risk of the United States and also directed him to see that the army was well supplied with Indian meal and vegetables. "It was a good deal urged," wrote Williams, "that the words pease, beans, etc. sho'd be inserted, but it was said they were included in vegetables, and it pasd as drawn." Evidently, however, Trumbull had not been altogether successful in carrying out this measure, for Elbridge Gerry wrote him December 26: "Is there no possibility of obtaining supplies of vegetables and vinegar for the army? The British troops are preserved from sickness by these means only, and I fear we shall never have a healthy and vigorous army without them." Naturally enough fresh vegetables would be scarce in midwinter, but vinegar, it would seem, should have been procurable.

Just three months later (March 26, 1777) Gerry again wrote to Trumbull: "I am glad to hear of your success in procuring supplies, and wish that measures may be immediately pursued to provide gardens for supplying the army daily with vegetables, and also to procure large quantities of vinegar. Without these the soldiery will be sickly and dispirited and the service injured if not ruined—pray attend to them as matters of the last importance. Few men can subsist on bread, meat, and water." On

April 19, Gerry wrote that Congress was about adopting new regulations for supplying the troops with vegetables and vinegar in sufficient quantities; and such a provision was actually embodied in the long and minute set of regulations adopted June 10, 1777.

This article of the regulations deserves to be quoted entire: "And whereas Experience has evinced that potatoes can be preserved in such a Manner as that the Crops of one Year will keep until that of the succeeding Year is fit for Use; the Com[missary] General or the D[eputy] Com[missary] Generals in each Department by and with the Advice of the Commander in Chief or Commander of the Department shall therefore fix upon one or more proper places in each Department in which to raise such Quantities of potatoes, Turnips, and other Vegetables as the Commander in Chief of a Department may direct, to rent Land therefore and employ persons to superintend and carry on the Works with a sufficient Number of Labourers."

Here we have a fairly good example of the dilatoriness of Congress in reaching its determinations. The plan of making gardens in the neighborhood of the army may not have been practicable in any case; but if it was to be tried at all, it should have been inaugurated in the early spring, at the time when the idea was first broached. To what extent it was tried out, whether at all, I do not know, but certain it is that in the beginning of August a committee which had been sent to the Northern (that is, the New York) army to investigate conditions, brought back the report that the number of sick "has been greatly increased by the use of bad bread and the want of vinegar, vegetables, and soap, as particularly set forth in General Washington's letter to the committee," and the committee recommended that measures be taken for the manufacture of vinegar and soap and the procuring of vegetables. While on that subject it may be mentioned that as late as July, 1778, Congress sent an express to Gov. Henry of Virginia, requesting him "to spare for the use of the army of the United States all the vinegar composing part of the cargo of the ship *Roderique*, purchased by the State of Virginia."

In the pursuit of the elusive salt, vegetables, and vinegar,

certain developments along the main line of the commissary business have been passed over. Trumbull was not long in finding his pay inadequate, and his friend Dyer suggested that he lay his case before Washington: "but", he said, "if it cannot be done by the way of the General I will endeavor to get some friend to introduce the affair before Congress at some proper time." A few days later Dyer suggested that the best way might be by a small commission, "which would go down much best with the multitude." This was just at the turn of the new year, 1776. The question of the amount of the commissary-general's pay was probably a matter of no great importance; but the question how he should be paid was of importance. It was about the same time, for instance, that the idea of supplying the army by contract began to seep into the Congressional mind, or to be thrust into it by people who wished to obtain such contracts. "Some of the Congress throw out once in a while," wrote Dyer to Trumbull, December 16, 1775, "as tho the Army might be Supplyd at a much less expence and with equally good provisions. they say now the rations Cost the Continent at least a shilling or 14d per diem lawfull and they have heard persons say in Philadelphia they would undertake for 7d or 8d pr diem. Indeed one Wharton has undertaken to Supply a Battalion lately raised here for 7d or 8d this Currency pr diem with the same rations found in the Army. perhaps you may make a bargain to advantage."

This new idea began to be mulled over by Congress, principally for some time out of doors, but presently Congress began actually to make contracts for supplying certain small units separated from the main army or only being recruited. As a result Trumbull's insistence upon better compensation made no headway until the spring of 1777, that is, something like a year and a half after the question had first been stirred.

A contributory factor to the delay and confusion was that same antagonism between New Yorkers and New Englanders to which allusion has already been made. From the New York department in particular demands were coming in that the contract method be adopted for that department, and Congress

at last, in September, 1776, tentatively approved of a plan for that purpose which had been prepared by General Schuyler.

While all this agitation was going on, there began to arise complaints of another character in another quarter. The nature and grounds of these complaints may well be gained from a letter which Roger Sherman, one of the Connecticut delegates wrote to Trumbull, April 2, 1777: "Your credit," says Sherman, "and I fear the public interest has suffered much from your employing a gentleman in this place to purchase provisions. There are great complaints against him that he gives very exorbitant prices and that the prices of articles have been much increased by his indiscretion. . . . Mr. Wharton is the person. . . . It is said that last winter Mr. Wharton made public declaration in this city that he was employed to purchase a large quantity of rum for the army and the highest price would be given, and that he gave like notice to the people in the country as to the purchase of pork and beef and other provisions. I don't know on what terms you employ people but sure I am it will not do to employ them to purchase on commissions unless you limit the prices: For the greater prices they give the more will be their profits, which is such a temptation as an honest man would not wish to be led into." Sherman was a wise man; and he was not the only member of Congress who foresaw the result of paying purchasing officers a commission on the purchase price; and yet only a little more than a year afterward Congress, in spite of clear and abundant warning, actually adopted that method. Even Trumbull himself, in a proposition which he presently submitted to Congress, included in one of his demands a commission on purchases. From all I can gather as to the man's character, such a method would have been fairly safe in his hands. At the very moment when these complaints against some of his deputies were so loud, Gerry wrote to Trumbull: "I have not heard any person lip complaints against the commissary general."

It was inevitable however that as a result of all these complaints, proposals, demands, agitation, and controversy Congress should resolve to investigate, and a committee was set upon the

task. The committee worked diligently at the problem for nearly three months and finally brought forward a plan for the reorganization of the commissary department, a plan so detailed in its requirements and prohibitions that the officers appointed under it must have had to burn many midnight candles before they had mastered it. The new organization itself was, however, simple enough. The business was divided into two departments, the purchasing and the issuing. At the head of the first was a commissary-general of purchase, of the second a commissary general of issues, each with a certain number of deputies; and it is to be observed that these were to be rewarded by means of salaries and rations. For instance, the commissary-general of purchases was to receive 8 dollars a day and 6 rations, the commissary-general of issues 150 dollars a month and 6 rations.

The document is well worth examination, for it is instructive in many ways. Merely as illustrating the extreme care which was taken to provide for every contingency, it may be mentioned that there were not only explicit instructions with regard to the killing of cattle and the preservation of the meat, but likewise with regard to hides, tallow, head, and tongues. One rather curious requirement was that every creature purchased for the use of the army should immediately thereafter be branded with the initial letters of the purchasing commissary's name, and the first creature purchased should be branded on the horns with the figure 1, the second with the figure 2, and so on. Evidently the committee was not thinking of hogs when this provision was written into the measure. It may also be needless to remark that it was soon found to be exceedingly difficult to comply with the regulations of Congress for branding and numbering ("exceedingly difficult" are the words set down in the Journals; I have not looked up the protest of the commissary-general, but I rather suspect that he used much stronger terms); and so Congress directed that the purchasers of live stock adopt such modes for marking as they shall judge expedient, but they were required to transmit to Congress by the earliest opportunity the regulations adopted by them for that purpose.

This brings us to the end of the first stage of the commissary

business of the Revolution, although there were some complications involved in the transition to the next stage which form a necessary part of the complete story. Trumbull was chosen, June 18, 1777, commissary-general of purchases under the new arrangement, but he had said emphatically that he would take the office on his own terms or not at all, and, as neither the committee nor Congress was willing to comply with all his demands, he shortly afterward handed in his resignation. The time soon came when, apparently, Congress, and most of the country as well, would have gladly had him again at the head of the business and almost on any terms. But it was not to be. His health had broken down under the strain of two years of perhaps as arduous and vexatious work as any man of that day except Washington had laid upon his shoulders; and on the 23d of July, 1778, scarcely a year from the time when he had laid down the task, he died.

Let me give merely a hurried glimpse of developments during the next two or three years. Immediately upon the resignation of Trumbull, William Buchanan, a deputy commissary-general of purchases, was promoted to the head of the department. Whether or not it was wholly or principally Buchanan's fault, the purchasing department soon went on the rocks. Complaints loud and long and fierce rolled over the country and in due time came pounding at the doors of Congress. Early in the autumn of 1777 great shortage of supplies developed, and Congress now and again thrust itself into the breach with special resolves, recommendations to the states, committees to superintend and to do this and that and the other in the business; but in spite of all of them the shortage grew rather than diminished. A committee was instructed, for instance, to hire mills, and have wheat ground into flour, purchase or impress wheat in the sheaf, and if the farmers could not be induced to thresh out their wheat, Washington was directed to detail men from the army to do it. One earnest recommendation to the state of Pennsylvania (December 10) was to require all persons to thresh out their wheat in a short period of time, under the penalty of having the wheat seized and paid for at the price of straw.

There was considerable revision of the commissariat regulations, most of them attempts to rectify the blunders which Congress itself had made, and of course Buchanan was investigated. But long-drawn-out investigations could not fill the empty stomachs of the soldiers.

You will remember that in the winter of 1778 Washington and his army were encamped at Valley Forge, while Congress was sitting at the small town of York in Pennsylvania. Just as the year 1777 was closing the army came into such immediate, such desperate want that Congress appointed a committee to do what was possible by interceding with the near-by state authorities and by other means. Impressment of supplies, wherever they could be found, became the order of the day. The greatest trouble at Valley Forge was not so much a lack of provisions, for it is said there was sufficient in the country for the needs of the army; it was chiefly a lack of transportation. It would probably be unjust to lay at the door of Mr. Buchanan the whole responsibility for the sickening failure which became the synonym of the commissary department; Congress itself had much to answer for. Indeed some members of Congress seemed inclined to make confession of the shortcomings of that body, as, for instance, when Eliphalet Dyer wrote February 17: "Congress are quite sick and discouraged on their late plan in the Commissary Department and of the person employed in the execution." While to another correspondent he declared that Congress had long been sick of its plan and were determined to alter it. Nevertheless they with one accord laid their sins on Buchanan's back and were about to turn him loose in the wilderness, when he escaped by resigning. This was on March 23, 1778.

All eyes were now turned toward Jeremiah Wadsworth, another deputy commissary-general of purchases and a Connecticut man, as the one man "whose abilities and exertions under Providence," as Dyer expressed it, "can relieve us." Wadsworth came, and on April 9 was appointed commissary-general of purchases practically on his own plan and terms. The most significant feature of the new plan was to give Wadsworth authority to appoint and control his own subordinates. As James Lovell expressed it in a

letter to Samuel Adams, April 19: "We have got Col. Wadsworth at the Head of the commissariate *unfettered* strictly so."

Still another important feature of the new plan, one already alluded to, was to reward purchasers by means of commissions on purchases. Congress was in good time to learn that old Roger Sherman was wise in decrying the commission plan, for it is not long before we begin to hear of frauds of various kinds and particularly of extravagant prices being paid for supplies. Before the end of the year, in fact, Congress began to consider the question of returning to a salary basis, and did in fact, on the first day of January, 1780, establish a salary for the commissary-general of purchases, his assistants being however left for the time on a commission basis.

The experience of Congress in rewarding purchasers by means of a commission on the purchase price is a chapter in itself and deserves to be told at length. I am not sure but that it ought to constitute a page, or a paragraph in bold type, in all our school histories. Had this been done through a generation preceding the World War, I am persuaded that the knowledge of it would have found lodgment in the minds that determined our legislation and our policies in that crisis, and in consequence we might have escaped the late lamented ten-per-cent-plus plan.

Wadsworth appears to have proved himself as capable and efficient as had been expected, although not even he was able to banish all confusion, speculation, and fraud from his department, to induce all his agents to follow the paths of righteousness, or to lead his country out of the wilderness of want into the land of plenty. Toward the end of the year 1779 the army was in almost as desperate straits for provisions as it had been the year before. In some respects the conditions were worse, for now the blighting breath of paper money was sweeping the country, withering the sources of supply, but at the same time generating new and unheard of forms of speculation, speculation, and fraud. In despair Wadsworth resigned in October, but was prevailed on to remain in office until the end of the year, when Ephraim Blaine, another deputy commissary-general of purchases, was promoted to his place. Blaine continued in office until practically the close

of the war. There is not time to make any survey of the conduct of the department under his direction nor of the problems that arose during his administration.

One development at the close of the year 1779 ought however to be mentioned. The supply problem, in addition to its own troubles, became so inextricably complicated with the paper money problem, the state quota problem, the tax problem (the last two items being two phases of one problem), that Congress at last resorted to the method of drawing (more properly requesting) specific supplies from the states. That is, the states were respectively asked to furnish in lieu of money quotas such and such quantities of flour, corn, pork, beef, etc. It is a curious chapter in the history of the business of supply and in that of finance, for it was as much a method of financing as it was a method of obtaining the necessary supplies.

ANCIENT MEDITERRANEAN AGRICULTURE

PART II. MANURING AND SEED SELECTION*

BY ELLEN CHURCHILL SEMPLÉ

The essence of ancient Mediterranean agriculture was the improvement of the soil, both in its mechanical and chemical composition. Working the land accomplished the first; manuring, the second; the biennial fallow contributed to both ends, while conserving the precious moisture in the soil.

Despite the fallow, overcropping was a persistent danger owing to the highly specialized utilization of the land, which arrested the development of crop rotation; owing also to the small amount of arable land rendered available by conditions of climate and relief. Olive groves were made to support a grain crop in alternate years; the *arbustum* field often yielded a second harvest between its vine-draped trees. The irrigated land with its summer and winter crop was doubly taxed and had to be doubly compensated; for the soil sends in its bill for every pound of plant food which is taken out.

MANURING

Hence the ancients developed the art of manuring to a surprising degree, in order to get a maximum yield from the limited tillage land and to replenish the nutriment in exhausted fields. In Palestine during the Mishnah period, irrigated land which was cropped twice annually was manured a second time before the summer seeding.¹ Everywhere irrigated hay meadows, which were mown three or four times a year, and alfalfa fields which yielded four or five harvests had to be amply fertilized at the planting.² Moreover, in years of heavy rains when soil moisture

* Part I of this article appeared in the April number of *Agricultural History*.

¹ H. Vogelstein, *Landwirtschaft in Palästina zur Zeit der Mišnah*. (Berlin, 1894), 24.

² Cato, *De Re Rustica*, 40; Varro, *Rerum Rusticarum*, I, 29; Pliny, *Historia Naturalis*, XVIII, 43 and 67.

was abundant, the farmer found he could avoid the economic waste of the fallow by judicious fertilization and some rotation of crops.

Without science the ancients evolved a scientific system of manuring, which became a conspicuous feature of their intensive tillage. They discriminated between various manures as to strength, and their relative value for different crops and different soils. Without chemistry they learned to conserve the important chemical elements of farm manure; and without bacteriology they learned how to get the maximum result from the bacteria in their compost heaps and their legume crops. They apportioned the amount of the manure to the quality of the soil, and in their gardens they practiced "head-fertilizing" (*kopfdüngung*) like the modern Japanese, feeding the individual plant rather than enriching the whole field.

Burdened with the labor of conserving the nutriment and moisture in the soil, the ancients looked with envy upon the easy tillage processes of Babylonia and Egypt. In the Tigris alluvium, "cultivation of the land consists in letting the water lie on it as long as possible, so that it may deposit much silt."³ Herodotus considered that the Egyptians of the Delta garnered the fruits of the earth more easily than all other people, for they escaped the endless toil of plowing, harrowing, hoeing and fertilizing which other men had to perform to obtain a crop of grain.⁴

ASHES PRIMITIVE MANURE

The first lesson in soil compensation was forced upon the peasants' notice. Stone Age cultivators burned the forests to clear the land, because their blunt axes made slow work of felling hardwood trees. Ashes were found to enrich the ground and adopted as the first obvious fertilizer in the Mediterranean countries as elsewhere. The ancient Jews set fire to briers, thorn bushes and other scrub growth.⁵ It was a common practice everywhere to burn the stubble of the previous crop on the land

³ Theophrastus, *De Historia Plantarum*, VIII, 7, 4.

⁴ Herodotus, II, 14.

⁵ *Exodus*, XXII, 6; *Isaiah*, IX, 18.

to clear the fields and destroy the weeds.⁶ However, this was an uneconomic method of converting the vegetable waste into fertilizer, because it dissipated the volatile elements like nitrogen and moisture; so most of the straw was utilized in other ways. But Cato advised the vine-dresser to burn the prunings of the vineyard on the spot and plough in the ashes to stimulate growth.⁷ The advice was sound since wood ashes supply lime, potash and phosphoric acid to the soil; and it is exactly the small shoots and twigs which contain these chemicals in great amount.⁸

The principle of applying various animal and vegetable refuse to the soil originated with the beginning of migratory agriculture. The droppings of the flocks and herds about the nomad camp or in the open pasture revealed their power to enrich the land. The invention of manuring was ascribed to various gods and heroes, notably to King Augeas of Elis and to Hercules,⁹ whose labor of cleansing the Augean stables by turning a river through them might be interpreted as the simultaneous application of irrigation and barnyard manure, a common practice among the ancients. The dunghill meets us in the courtyards of Ulysses and Laertes his father;¹⁰ it was very ancient among the Jews who probably learned its value from the local Canaanites.¹¹ They carried all the manure of Jerusalem from the city by the Dung gate to the gardens outside.¹² The power of dead bodies to fertilize the ground after a battle or execution was known to the Greek Archilochus by 700 B.C.¹³ and even earlier to the Jews.¹⁴ Jeremiah emphasized the value of bone-dust,¹⁵ and Deuteronomy directed the blood of slaughtered animals to be poured out on the ground, a practice which persisted for centuries.¹⁶ The tragic

⁶ *Isaiah*, V, 24; Xenophon, *Oeconomicus*, XVIII, 2; Vergil, *Georgic I*, 84.

⁷ Cato, 37.

⁸ W. P. Brooks, *Agriculture* (Springfield, Mass., 1905), II, 282.

⁹ Pliny, XVII, 6.

¹⁰ *Odyssey*, XVII, 297-299; XXIV, 225.

¹¹ *I. Samuel*, II, 8; *II Kings*, IX, 37.

¹² *Nehemiah*, II, 13.

¹³ Plutarch, *Marius*, XXI.

¹⁴ *Jeremiah*, IX, 22; XVI, 4; *II Kings*, IX, 37.

¹⁵ *Jeremiah*, VIII, 1-2.

¹⁶ *Deuteronomy*, XII, 16, 24; XV, 23; Vogelstein, *op. cit.*, 19.

fertility of old battle-fields belonged to the spot where Caius Marius wiped out the Teutonic horde at Aquae Sextiae in 102 B.C. "They say that the soil, after the bodies had rotted and the winter rains had fallen, was so fertilized and saturated with the putrefied matter which sank into it, that it produced an unusual crop the next season."¹⁷ This effect was doubtless observed wherever men fought and tilled the land, from Megiddo to Flanders field.

"I sometimes think that never blows so red
The rose as where some buried Caesar bled."

FARM MANURES

The main source of animal manures was in the flocks and herds, whose value came largely from the dung to enrich the soil, according to Varro.¹⁸ To maintain a proper balance between live stock and crops was difficult for the Mediterranean farmer, because the long summer drought necessitated keeping his animals for five or six months every year on the mountain pastures. Hence nearly half their manure was lost to the home farm. The amount available for the fields was limited to that provided by the few stall-fed oxen, asses and mules kept on the farm as work animals during summer; and by the returning flocks and herds which were pastured during winter on the home land. It was customary to fold them at night on the meadows, shifting them systematically, so that their droppings were evenly distributed. Their fresh manure insured a good stand of grass.¹⁹ This method of applying the manure saved waste of organic material and of labor, but was best suited to meadows. For grain crops old rotted manure was best. The dunghill possessed special importance in dry countries like Palestine, Syria, Asia Minor and Greece, because it supplied humus to the soil. This element of plant food is always scant in clean-cultured fallow fields and in the thin herbage of semi-arid soils. To husband his manure was the farmer's first duty. Xenophon criticized peasants who failed to collect

¹⁷ Plutarch, *Marius*, XXI.

¹⁸ Varro, *R. R. Praefatio*, 4.

¹⁹ Cato, 30; Columella, *De Agricultura*, II, 15, 9; Pliny, XVIII, 53; Vogelstein, *op. cit.*, 19-21.

dung.²⁰ Gathering it from stall and sheepcote was a regular task of the farm of Ulysses in Ithaca.

Greeks and Romans employed human excrements and the dung of cows, horses, asses, sheep, goats, swine, poultry, pigeons and various other birds. The Jews used the manure of these animals and also that of camels, but from human sources only the urine, which was applied in diluted form to the land.²¹ These several animal manures were known to possess various degrees of efficiency, because they had been tested for ages and their relative values estimated, as Pliny states.²² The surprising fact is how closely the ancient estimates agree with the results of chemical analyses made in modern agriculture laboratories, though the ancient authorities differed in details from each other.

Theophrastus ranks manures in point of richness or concentration as follows: (1) human excrements, (2), that of swine, (3), of goats, (4), of sheep, (5), of cows and oxen, (6), of beasts of burden or horses, mules and asses. He adds that these are different from one another and need to be differently applied.²³ He explains that manure of beasts of burden is "bad because it is most apt to lose its moisture."²⁴ This was true if the manure was placed only half rotted in a dry soil during a dry season, such as Attica provided.

The Roman authorities considered bird and chicken manures the richest, especially the droppings in dovecotes and aviaries; but they ranked low the excrements of ducks and geese,²⁵ a significant evidence of their close observation. In this opinion modern agricultural chemists concur. Poultry manure combines the solid and liquid elements with a minimum loss of the latter, which contains most of the nitrogen, while the solid matter contains large percentages of potash and phosphoric acid. Pigeons' manure is the richest; hens' manure stands next. Much

²⁰ Xenophon, *Oeconomicus*, XX, 10; Cato, 5.

²¹ Vogelstein, *op. cit.*, 18-20.

²² Pliny, XVII, 6.

²³ Theophrastus, *Hist. Plant.*, II, 7, 4.

²⁴ Theophrastus, *De Causis Plantarum*, III, IX, 2; *Hist. Plant.*, VII, 5, 1.

²⁵ Varro, I, 38; III, 7; Columella, II, 15.

lower comes ducks' manure, and that of geese ranks far down in the scale.²⁶ The differences are largely the result of different feeding; pigeons and poultry have concentrated food. The ancients, too, recognized that the feed of animals affected the quality of the manure. For instance, cytisus or snail clover, a popular legume fodder lauded by Columella, was thought to enrich all animal excrements.²⁷

Varro's list, quoted from Cassius (40 B.C.) who probably relied on Mago, is as follows: (I) Manures of birds and fowls. (II) of human beings. (III) That of goats, sheep, swine and asses. (IV) That of horses and draught animals fed on barley. This, however, was the best for meadows, because it stimulated the herbage.²⁸ Columella accepted this classification as to groups; but for farm dung he ranked the ass first, sheep second, goats and horses third, and swine lowest.²⁹ Modern experiments corroborate these ancient estimates, especially for swine dung and human manure. The former is rich in phosphoric acid but poor in nitrogen, the element most needed by Mediterranean soils; the latter contains high percentages of nitrogen and phosphoric acid. It was so concentrated that Columella advised its being diluted or mixed with farm refuse, lest it burn the soil. When properly handled, it was excellent for vines and fruit trees, which therefore ought to be planted near the bagnios. In undiluted form it was good for poor sandy land.³⁰

COMPOST HEAP

The chief dependence of the ancient farm was the manure pile. Therefore it received the best care. It was kept preferably in a water-tight cemented pit covered over to prevent loss of its moisture by drainage, leaching or evaporation, and was kept a year to rot before being placed on the land.³¹ Straw, leaves, weeds from the fields, reeds and sedges from swamps or willow

²⁶ W. P. Brooks, *op. cit.*, II, 233-234.

²⁷ Pliny, XVII, 6.

²⁸ Varro, I, 38.

²⁹ Columella, II, 15.

³⁰ Columella, I, 6; II, 16; V, 10; Pliny, XVII, 6.

³¹ Columella, I, 6; Pliny, XVII, 8.

plots were bedded under the farm animals,³² and when trodden down added to the bulk and humus value of the manure,³³ beside conserving the urine. Isaiah speaks of "straw trodden down for the dunghill."³⁴ Into the compost heap went every form of organic refuse,—chaff, husks, pods, dead leaves, ferns, bean stalks, lupine straw. Columella added to this list weeds from the hedgerows, ashes, sewage and every kind of waste; and he emphasized the value of vegetable refuse on farms without cattle.³⁵ Xenophon found that weeds gathered from the fields and allowed "to rot in stagnant water made good manure to gladden the field."³⁶ To these various organic ingredients of the compost heap salt was added in Palestine. "Salt that has lost its savour is fit neither for the land nor for the dunghill."³⁷ Its value lay in its power to retain moisture, retard decomposition, and react on certain inert compounds, so that their lime and potash were more available.³⁸

When the contents of the compost heap were well rotted, they were carted out, spread on the land, and ploughed in promptly to conserve moisture. This was done in Italy after a rain in September for an autumn crop, and for a spring crop in late winter when the ground was still wet.³⁹ There was a period when the manure was at its best. If too new or imperfectly rotted, it burnt the seed and the roots of trees;⁴⁰ if kept longer than a year it lost strength.⁴¹ Concentrated manures, if undiluted or applied in excess, were likely to burn and dry out the soil. "The dung most recommended is that which is mixed with litter," is the generalization arrived at by Theophrastus;⁴² for the ancients like the

³² Cato, 5 and 37.

³³ Theophrastus, *Hist. Plant.*, VII, 5, 1.

³⁴ Isaiah, XXV, 10.

³⁵ Vogelstein, *op. cit.*, 19; Cato, 5 and 37; Columella, II, 15.

³⁶ Xenophon, *Oeconomicus*, XX, 11.

³⁷ Luke, XIV, 35.

³⁸ W. P. Brooks, *op. cit.*, II, 315.

³⁹ Cato, 5; Pliny, XVIII, 53.

⁴⁰ Pliny, XVII, 46.

⁴¹ Columella, II, 15.

⁴² Theophrastus, *Hist. Plant.*, VII, 5, 1. Compare Xenophon, *Oeconomicus*, XVIII, 2.

moderns recognized the effect of litter in diluting manure,⁴³ and they apparently adopted a rule for the proportion of bedding to be used. "Where sheep furnish a cartload of manure, the larger cattle should furnish ten loads; otherwise it is clear proof that the husbandman has littered his animals badly."⁴⁴ A standard bulk gave a standard strength, so far as this was affected by the litter and not by the kind of dung. Very rich manures, like human excrements, which ferment quickly, were regularly diluted.⁴⁵ Bird and pigeon guano was powdered and thinly strewn over field and garden,⁴⁶ as it is today for the same reason.

A study of the treatment and application of animal manures by the ancients reveals a painstaking adjustment to climatic conditions, especially to the long summer period of warmth and drought, when the soil contains insufficient moisture for the decay of organic matter. Stable manure rots with great difficulty on or in land which contains scant moisture, because the necessary bacteria do not develop there in sufficient amount to produce the proper chemical changes in the manure. Unrotted manure keeps the soil open, allows its precious moisture to escape, and burns the crop. For this reason many dry farmers in semi-arid America do not use stable manure.⁴⁷ The ancients met this difficulty by composting the manure for a year to insure its complete decay, soaking it with its own fluids or with water when it became too dry, and turning it frequently to admit the air.⁴⁸ The final product of this organic decay was humus or mould, which might be seen "passed through a sieve like so much flour, and perfectly devoid, through lapse of time, of all bad smell or repulsive appearance."⁴⁹

⁴³ W. P. Brooks, *op. cit.*, II, 208.

⁴⁴ Pliny, XVIII, 53.

⁴⁵ Theophrastus, *Caus. Plant.*, III, 9, 2; *Hist. Plant.*, VII, 5, 1.

⁴⁶ Cato, 36; Varro, I, 38; Pliny, XVIII, 53.

⁴⁷ Wendell Paddock and Orville B. Whipple, *Fruit Growing in Arid Regions* (New York, 1914), 197.

⁴⁸ Columella, I, 6.

⁴⁹ Pliny, XVII, 6.

AMOUNT OF MANURE

From motives of economy and concern for a successful crop, the ancient farmer used no more manure than was absolutely necessary. "They tell us to manure a thin soil abundantly and a rich soil sparingly, both on account of the fertility of the soil and because the muck brings more nutriment than the land is able to take care of." Thus Theophrastus reports the general practice of farmers who feared the consequences of excessive manuring.⁵⁰ "It is better to manure little and often than in excess" was the Roman motto.⁵¹ Therefore after a fallow season, when the ground would have partly recuperated its strength, manures were applied only to very poor land or to very exacting crops like beans, hemp, alfalfa and barley.⁵² "Flax, oats and the sleep-giving poppy exhaust the soil, but it is easy to sow them in alternate years, provided you do not fail to soak the dry earth with rich muck and scatter foul ashes over the exhausted fields," says Vergil.⁵³

The amount of manure customarily used under average conditions of soil and weather is specified by Columella. For a *jugerum* of hillside land 24 loads of 80 *modii*, or 492 bushels, sufficed; this equalled 788 bushels to the acre. On level land only 18 loads per *jugerum* or 525 bushels per acre were required, though the larger amount was used on a field prepared for a bean (*faba*) crop immediately after a grain crop.⁵⁴

But weather conditions modified both the amount of manure and the method of its application; because a timely rain abated the danger attending excess. In an average autumn it was customary to manure the field just after a rain, then sow it, plough in seed and dung together, and then ridge and harrow;⁵⁵ but some farmers preferred to cast the manure and seed together.⁵⁶ The

⁵⁰ Theophrastus, *Caus. Plant.*, III, 20, 2. Compare Pliny, XVIII, 53.

⁵¹ Columella, II, 16.

⁵² Columella, II, 5, 10, 21, 23, 27, 31; XI, 2.

⁵³ Vergil, *Georg. I.*, 77-81.

⁵⁴ Columella, II, 5, 16; Palladius, X, 1, 2.

⁵⁵ Columella, II, 10.

⁵⁶ Theophrastus, *Hist. Plant.*, VII, 5, 1.

interval left between the two operations was always short, because the dung was known to loosen and warm the soil, thereby stimulating germination.⁵⁷ Some farmers spread the manure between the upper and under soil, where it was easily reached by the rain and carried down to the roots of the plants, but where it was protected from the desiccating heat of the sun.⁵⁸ This method preserved not only moisture but also the important chemical constituents in the fertilizer. Cato advised scattering pigeon guano over meadow, garden or sown field, further to enrich the land.⁵⁹ Instead of the regular manuring, where this had been omitted, it was necessary to spread the land with aviary dust just before the mid-winter hoeing.⁶⁰ At that season the rains would carry this rich fertilizer down to the roots as a tonic to the crop.

Always loomed the danger of excessive manuring. This was known to kill trees and grain crops, unless they got a saving shower. Therefore in rainy localities, frequent and abundant manuring was safe and efficacious; but in arid districts or in thin dry soil a moderate application was the wise course,⁶¹ and the avoidance of highly concentrated manures. To obviate all difficulty in a hot dry region, it was customary to fill the furrows or trenches with water and allow three days for its absorption, then throw the manure on this saturated soil, then plant and cover.⁶²

MANURING AND IRRIGATION

Rich, concentrated manures, whose plant food was quickly available, were generally used in gardens and orchards which needed quick feeding; but to obviate the danger of burning, they were applied in diluted form or were combined with regular irrigation. In the Aegean lands night soil and swine dung were applied with irrigating water to pomegranate and almond trees to improve

⁵⁷ *Ibid.*, VIII, 7, 7.

⁵⁸ Theophrastus, *Caus. Plant.*, III, 6, 1.

⁵⁹ Cato, 36.

⁶⁰ Pliny, XVIII, 53.

⁶¹ Theophrastus, *Caus. Plant.*, III, 9, 2.

⁶² *Ibid.*, III, 6, 2.

the flavor of the fruit and reduce the size of the seed or nuts.⁶³ In Italy, pomegranate trees were watered four times yearly with diluted human urine at the rate of one *amphora* or seven gallons to the tree.⁶⁴ Columella advises this treatment for vines and various fruit trees to improve the flavor and aroma of the fruit.⁶⁵ All the waste from the olive oil presses, the *amurca* and the rotted lees were applied in the same way to fruit trees and vegetables;⁶⁶ and therefore Columella advised that gardens and orchards be located near the poultry yards, *bagnios* and olive waste receptacles.⁶⁷ But Theophrastus advised great discrimination in the selection of manures, "for the same manure is not equally suited to all kinds of trees. The age of the tree also makes a difference."⁶⁸ Even the organic waste from the currier's shop consisting of wool, hair and leather scraps was used for vines and fruit trees; but as this material was rich and rotted slowly, it too was combined with irrigation.⁶⁹

Vegetables were equally avid of rich diluted manure. Theophrastus laid down the principle that all plants needing much nutriment needed also much water. Most vegetables germinated quickly, within five to ten days, and grew rapidly; hence their demand for food and ample water.⁷⁰ "All the pot-herbs are lovers of water and dung."⁷¹ Both were necessary to cucumber and gourds.⁷² When applied to cabbages in small quantities, they produced heads of the finest flavor; but in larger amounts, they produced larger heads of inferior flavor.⁷³ The truck gardens and olive groves about Athens were enriched by the sewage of the ancient city. The main *cloaca* or sewer ran across the city and through the Dipylon to a reservoir outside, from which

⁶³ Theophrastus, *Hist. Plant.*, VII, 51; *Caus. Plant.*, III, 9, 3; Columella, V, 10.

⁶⁴ Pliny, XVII, 47.

⁶⁵ Columella, II, 15.

⁶⁶ Cato, 93.

⁶⁷ Columella, I, 6.

⁶⁸ Theophrastus, *Caus. Plant.*, II, 9, 5; *Hist. Plant.*, II, 7, 3-4.

⁶⁹ Pliny, XVII, 46.

⁷⁰ Theophrastus, *Hist. Plant.*, VII, 1, 3.

⁷¹ *Ibid.*, VII, 5, 1.

⁷² Pliny, XIX, 24.

⁷³ Pliny, XIX, 41.

square or cylindrical brick-lined canals carried the contents to the intensively cultivated plain of the Cephissus valley, with its orchards and farms. One of these canals seems to show a device for regulating the flow, and suggests that the sewage was sold to the farmers.⁷⁴

MINERAL FERTILIZERS

All this sounds modern and scientific. Still more does the ancient use of mineral fertilizers. These were found in their native state, either as earths like marl, or as deposits of alkaline salts like carbonate of lime and nitrate of potassium (nitre). Mixing different kinds of earth was first advocated by Theophrastus as "a means of remedying defects and adding heart to the soil."⁷⁵ Such mixtures improved both the chemical and mechanical composition of the soil, for the added ingredients were either direct or "indirect fertilizers." The value of alkaline earths was early recognized, notably in prehistoric Aegina, where their use became a theme of mythology. On this small and populous island the surface stratum of poor freshwater limestone was underlaid, one or two yards below, by a stratum of fertile marl. So the inhabitants pierced the sterile veneer, dug out the marl, mixed it with the soil above, or even spread it on the bare rocks to create a field.⁷⁶ This habit of burrowing underground and using the excavations as dwellings fastened on the early Aeginetans the name of Myrmedons or ants.⁷⁷ Likewise in nearby Megara, where a poor surface soil was underlaid by thick strata of various marls,⁷⁸ the same thing was done with good effect.⁷⁹

The Romans imitated the practice of the Greeks and Gauls in the use of marl. They distinguished several varieties, and ap-

⁷⁴ Article on *Cloaca* in Smith, *Dictionary of Greek and Roman Antiquities* and Pauly-Wissowa, *Real-Encyclopädie der classischen Altertumswissenschaft* (Stuttgart, 1901).

⁷⁵ Theophrastus, *Caus. Plant.*, III, 20, 3.

⁷⁶ C. Neumann and J. Partsch, *Physikalische Geographie von Griechenland* (Breslau, 1885), 348.

⁷⁷ Strabo, VIII, 6, 16.

⁷⁸ A. Philippson, *Der Peloponnes* (Berlin, 1892), 16.

⁷⁹ Theophrastus, *Caus. Plant.*, III, 20, 4.

plied them to grain and meadow lands, but they found the tufaceous and calcareous kinds the best for cereal crops. Like the modern farmers, they spread it very thinly on the ground to avoid burning, and found one such treatment sufficient for many years, though not fifty, as Pliny says. The white variety, if procured in the vicinity of springs (calcium carbonate) "rendered the soil immeasurably fecund for grain."⁸⁰ Columella advocated spreading marl on a gravelly soil or of mixing gravel with a dense calcareous soil, "as I have seen my uncle do. Thus he raised fine cereal crops and beautiful vineyards."⁸¹ This uncle was a gentlemen farmer, a Roman colonist in Spain, who cultivated his estate near Corduba (Cordova) on the Guadalquivir River.

Lime was added to the soil in other forms, either as broken or powdered limestone, which was applied to orchards, vineyards and olive groves,⁸² or as pumice stone and shells.⁸³ It was also provided by wood ashes, which were widely used as fertilizer in all parts of the Mediterranean region,⁸⁴ and which supplied phosphoric acid and potash as well as lime. Lime from the limekilns proved excellent for olive trees.⁸⁵ Some farmers living north of the Po and having a superfluous dung from their big herds of cattle, burned part of the manure by preference and applied the light ashes to the field.⁸⁶ Lime in any form was used to correct an acid soil. Sand was frequently mixed with a heavy clay or chalk soil to improve its mechanical composition in gardens and orchards,⁸⁷ and occasionally to facilitate drainage where the land had become saline.⁸⁸ Pliny disclaims any virtue in such a mixture, even when a red or black or white sand was combined with a rich earth.⁸⁹

⁸⁰ Pliny, XVII, 4, 6-8.

⁸¹ Columella, II, 16.

⁸² Pliny, XVII, 4, 47.

⁸³ Vergil, *Georg. II*, 348-350.

⁸⁴ Vogelstein, *op. cit.*, 19-20; Pliny, XVII, 5, 47; Vergil, *Georg. I*, 80.

⁸⁵ Pliny, XVII, 6.

⁸⁶ Pliny, XVII, 5.

⁸⁷ Vogelstein, *op. cit.*, 19-20; article on horticulture in *Jewish Encyclopedia*.

⁸⁸ Theophrastus, *Caus. Plant.*, III, 6, 3.

⁸⁹ Pliny, XVII, 3.

Sometimes the soil needed other elements. Nitre (nitrate of potassium) and salt were found beneficial to certain vegetables; therefore they were either sprinkled over the garden plots or applied in solution to the plants.⁹⁰ Radishes, beets, rue and asparagus were among the vegetables so benefitted both in flavor and growth.⁹¹ Nitre removed the excessive pungency of radishes, and increased the size of beans.⁹² Palm trees, which were known to require a saline soil, were treated with salt or brine about their roots.⁹³

GREEN MANURE CROPS

The drawback of these mineral fertilizers was their failure to supply humus, which was especially needed on arid soils and on clean-cultured fallow land. Hence the ancients scarcely relied on them to take the place of animal manures; but they devised instead by 400 B.C. or even earlier a system of green manure crops, which was also an improvement on the old fallow field system. Xenophon states that a green crop ploughed in enriches the soil as manure does,⁹⁴ but he does not specify the kind of crop. Theophrastus, however, reports that the farmers in Thessaly and Macedonia raised a bean crop and turned it under when it was in flower; because the bean (*faba vicia*) reinvigorated the soil, even when it was sown thickly and produced much grain. The reason he assigned for this effect was that "the plant was of loose growth and decayed quickly."⁹⁵ In his later book he makes the generalization that legumes do not take strength from the cultivated land but rather give it new strength. He made an exception however in the case of chick peas, because they required rich black soil and only served to exhaust the land.⁹⁶ In this opinion Cato concurred, specifying field beans, lupines and vetch as the best green manures for grain crops.⁹⁷ For thin soil Varro advocated ploughing in

⁹⁰ Pliny, XIX, 41; Luke, XIV, 35; Theophrastus, *Caus. Plant.*, III, 7, 8.

⁹¹ Pliny, XIX, 59.

⁹² Pliny, XIX, 26; Vergil, *Georg. I*, 194.

⁹³ Theophrastus, *Caus. Plant.*, II, 5, 3; III, 7, 1-4.

⁹⁴ Xenophon, *Oeconomicus*, XVII, 10.

⁹⁵ Theophrastus, *Hist. Plant.*, VIII, 7, 2; IX, 1.

⁹⁶ Theophrastus, *Caus. Plant.*, IV, 8, 1-3.

⁹⁷ Cato, 37 and 54.

snail clover or beans before they began to pod.⁹⁸ Columella enumerated lupines, beans, vetches, lentils, chick peas and other pea varieties as renovating crops, provided they were ploughed in as soon as the green fodder crop was harvested, before the fresh roots should become dry and withered. Clover and alfalfa, after they had yielded fodder for their appropriate number of years, were turned under when the crop began to deteriorate.⁹⁹

All the ancient authorities agreed however that the most economical and satisfactory green manure crop was lupines; it would thrive on dry, sandy, or gravelly soil or on *terra rossa*,¹⁰⁰ gave food for man and beast, was cheap to seed, quick to grow, blossomed three times; and to enrich the ground should be ploughed in just after the third flowering, or if planted on sandy soil, after the second flowering.¹⁰¹ Moreover it was so vigorous that it competed successfully with weeds and underbrush.¹⁰² Green lupine stalks enriched the soil exceedingly.¹⁰³ This ancient estimate of lupines as a green manure crop is sustained in every point by modern scientific agriculture.¹⁰⁴

By age-long experiment the ancients learned the power of legumes to open up and mellow the soil by their thick, deep-running roots; to keep down weeds by their thick cover growth and deeper roots; to put more nutriment into the soil than they took out of it; to increase the farm income by substituting a food crop for an idle fallow which demanded constant tillage; and especially the great economic profit in growing legumes like lupines or vetch, which would thrive on poor dry soils, as compared with chick peas which required a rich heavy loam. The ancients reveal a deep understanding of the manurial value of green legume crops, when they raised mixed fodder crops of legumes and grains;¹⁰⁵ and especially when they "found it very

⁹⁸ Varro, I, 23, 2-3; Pliny, XVIII, 30.

⁹⁹ Columella, II, 10 and 14.

¹⁰⁰ Theophrastus, *Hist. Plant.*, VIII, 11, 8; *Caus. Plant.*, IV, 7, 3.

¹⁰¹ Columella, II, 10; XVII, 6; Pliny, XVIII, 36.

¹⁰² Theophrastus, *Hist. Plant.*, I, 7, 3; VIII, 11, 8.

¹⁰³ Columella, II, 15; Pliny, XVII, 6.

¹⁰⁴ W. P. Brooks, *op. cit.*, II, 360.

¹⁰⁵ Varro, I, 31; Pliny, XVIII, 41-42.

profitable to sow garlic and onions between the rows of cytissus or snail clover,"¹⁰⁶ thereby anticipating the interculture of vegetables and legumes practiced today in intensive Japanese horticulture.

The ancients achieved results without chemistry and bacteriology, which have revealed the nitrogen-gathering bacilli harbored by the roots of legumes. These fix the free atmospheric nitrogen and incorporate it in the soil in the form of nitrates; thus they capture the most valuable and elusive element of plant food. The successful cultivation of legumes in all Mediterranean lands from earliest times indicates that the necessary bacteria were widely distributed. But the mixing of soils of different kinds, advocated by Theophrastus, may have owed its efficacy, so far as legumes were concerned, to the inoculation of the field with the necessary bacteria. This method of preparing land for clover crops has been practised in Kentucky for a hundred years or more, by borrowing a few barrels of soil from a neighbor's clover field; and it is now advocated by the United States Department of Agriculture.¹⁰⁷ Finally the ancients did not plough in the legume crop till the plants gave signs of podding; they postponed the operation till the critical date, taught only by long experience and observation. Modern laboratory experiments show that legumes of all kinds take nitrogen from the air in largest proportion as they approach maturity; so the ancients had sound basis for their practice.¹⁰⁸

ROTATION OF CROPS

Rotation of crops was apparently inaugurated by the alternate planting of grains and legumes. Rye was the only other crop definitely used to enrich the soil; but its use for this purpose came in late and was restricted to the upper Po Valley where the grain found a favorable rainfall.¹⁰⁹ But Pliny also indicates the ploughing in of millet and panic in the Alpine piedmont to ferti-

¹⁰⁶ Pliny, XIII, 47.

¹⁰⁷ J. M. Westgate, "Alfalfa," *Farmers' Bulletin* 339 (Washington, 1908), 17-18.

¹⁰⁸ W. P. Brooks, *op. cit.*, II, 365.

¹⁰⁹ Pliny, XVIII, 40.

lize the soil; he states that this was done just as the stem began to develop or had put forth two or three leaves.¹¹⁰

Otherwise, rotation of crops made limited progress. Varro advised that, in lieu of the fallow, the land be planted lightly with some other crop less exhausting than grain.¹¹¹ The fertile Neopolitan plain was cropped all year round, once with panic, twice with spelt, and occasionally a fourth time with vegetables,¹¹² —a series not calculated to conserve plant food. Pliny gives another rotation suited to black, friable soil of the kind described by Cato as "tender;"¹¹³ first barley, then millet, then rape, and finally barley again or wheat, with no cultivation between beyond ploughing when the seed was sown. Yet another rotation was spelt succeeded by a four-months' winter fallow, then spring beans, then winter beans.¹¹⁴ This series provided amply for the compensation of the soil. The Romans had an effective system to renovate a worn-out meadow. After thorough ploughing, the field was planted in beans, rape, or millet, the next year in wheat, and the third year in some hay crop like clover or grass.¹¹⁵ An old tenant's contract of Palestine in Mishnah times provided that barley should be raised the first year, onions the sixth of the Sabbatical cycle, and flax one year between; but beyond this it indicated no system of rotation.¹¹⁶ Greek authorities mention only the alternation of legumes and grain.

Despite Vergil's generalization that "the fields rest by a change of crops,"¹¹⁷ rotation was little practised. This was the weak spot in ancient agriculture. It may have resulted from the conservative allocation of crops to selected terrains and soils, combined with the prevalence of small, naturally defined districts, in which exchange of crops between different fields was difficult or economically impossible. Consequently the persistent discrimination in

¹¹⁰ Pliny, XVIII, 49.

¹¹¹ Varro, I, 44, 2.

¹¹² Strabo, V, 4, 3; Pliny, XVIII, 29.

¹¹³ Cato, 151.

¹¹⁴ Pliny, XVIII, 52.

¹¹⁵ Pliny, XVIII, 67.

¹¹⁶ Vogelstein, *op. cit.*, 50.

¹¹⁷ Vergil, *Georg. I*, 82-83.

the use of certain soils for certain crops tended to crystallize into a rigid system. Rotation was restricted before it could advance. General farming, with balanced stock-raising and diversified field agriculture on a fairly ample scale, developed only in regions of low relief and abundant water, like the Nile and Po valleys; or in smaller districts of moderate relief and high fertility, like the hill-and-dale country about the old volcanoes of Etruria and Sicily, or like the productive lake basins of Greece. Moreover, the large area in all Mediterranean lands devoted to permanent plantations of orchards and vineyards contributed to this fixation of crops by restricting the arable land susceptible of rotation. The fallow system worked to the same end by halving the amount of land available at any one time for field agriculture. The result was the constant danger of over-cropping, and the steady evolution of manuring to safeguard the soil from exhaustion.

SEED SELECTION

The principle of seed selection was early advocated by the ancient farmers as a prime means of improving crops; and in the first decades of the Roman Empire it reached a development which has only recently been attained in America. This gospel, now preached by agricultural colleges, was adumbrated in the Hebrew Scriptures. The biblical injunction, "Thou shalt not sow thy field with mingled seed"¹¹⁸ was evidently intended to make the Judean peasant scrutinize his seed corn and eliminate adulterations, in order to get a clean crop. It was a kind of precautionary weeding. But the sorting process inevitably led to the rejection of imperfect specimens of the desired grain, and hence was an initial step in seed selection. The injunction, which is found in Leviticus, dates back to the eighth or ninth century B.C., and like other agricultural methods was probably borrowed from the local Canaanites; for the early folk tale of Ishobeth describes the door-keeper of the Israelite prince, drowsing in the noonday heat over his task of cleansing wheat for his master.¹¹⁹ The practice

¹¹⁸ *Leviticus*, XIX, 19; *Deut.* XXII, 9.

¹¹⁹ *II Samuel*. IV, 5-6 (revised version).

was still current in the time of Josephus;¹²⁰ and in the New Testament the sowing of "good seed" is stressed.¹²¹

Jewish farmers, in the first and second centuries of our era, planted seed beds for the purpose of getting a superior quality. The plain of Jericho was divided up into numerous small plots of wheat and barley; for the soil was rich on this old river terrace of the Jordan, and irrigation from spring or reservoir insured sufficient water. Elsewhere whole fields were cut up into beds, each planted with a different seed. The Jews carried on a trade in seed-corn and made purchases by tested seed or by samples, much like the little trays of wheat carried about the market by the grain merchants of ancient Athens. They tested seed by planting a few in an earthen pot or a manure bed, and judged the vitality by the rapidity of germination.¹²² This method recalls the miniature "gardens of Adonis," offered to the youthful god of spring throughout Syria from remote times. They consisted of seedling grains or vegetables raised in earthen pots by some forcing process, and may possibly have been either cause or effect of early experiments in seed testing.

The principle of seed selection emerges more clearly among the ancient Greeks. Aristotle observed that a good plant was not likely to grow from a bad seed, nor a bad plant from a good seed,¹²³ under proper conditions of climate and soil. Theophrastus voiced a general opinion of Hellenic farmers that seeds of herbs and vegetable collected from plants in their prime showed their superior vitality by rapid germination. Hence when the plants were at their best it was customary to gather the seed and dry them, since well cured seed were known to produce more fruit.¹²⁴ Theophrastus also stressed the importance of the youth of the seed: for all crops, whether grain or vegetables, the seed of the year was considered the best; next best was that of the previous year, and poorest that of the third year before. Beyond this the

¹²⁰ Josephus, *Jewish Antiquities*, BK. IV, chap. viii, 20.

¹²¹ *Matthew*, XIII, 24-30.

¹²² Vogelstein, *op. cit.*, 38-43.

¹²³ Aristotle, *De Plantis*, I, 6; II, 6.

¹²⁴ Theophrastus, *Hist. Plant.*, VII, 3, 3-4.

seed was likely to be sterile, though still suitable for food. Some exceptions to this rule depended upon the locality of production and preservation; for in high, windy regions seed seemed to retain their vitality longer.¹²⁵ Age affected the rapidity of germination also in garden plants. Fresh seed in general sprouted more quickly, though celery, beet, coriander, parsley and some others came up more promptly from older seed.¹²⁶ Moreover, the Greek farmers discovered that all vegetables were greatly improved in size and quality by transplanting; therefore they took special care to transplant those reserved for seed collection.¹²⁷ A similar tendency to coddle seed nurseries prevailed in Italy. Pliny states that cabbage plants intended for seed were never cut.¹²⁸ Cato devoted great care to his seed-plots.¹²⁹

The Greeks experimented with choice seed from different countries, in consequence of the extensive importation of over-sea grains, fruits and vegetables. For instance, a three-months Sicilian wheat was tried in Achaia, where it failed to yield a crop; but it was raised successfully in the southern part of the island of Euboeia, which was exposed to the warm, rainy south wind (Notos) of spring. Experiments with seeds from various climates and soils about the Mediterranean shores led to an interesting generalization formulated by Theophrastus: "Each seed of the several seed kinds is adapted to the natural conditions of its native habitat, both genera as compared with genera and the different species of the same genus. It is wise to transfer seed from a warm region to one a little less warm, and from a cold region in the same way. . . . Those which are transplanted from far northern lands to a hot district unfold their flower so late that they are caught by the summer drought, unless they are saved by the late rains of spring. Wherefore, according to the general opinion, care should be taken to prevent them from becoming mixed with the local variety, unless they come from

¹²⁵ *Ibid.*, VII, 5, 5; VIII, 11, 5. Compare Pliny, XVIII, 54.

¹²⁶ Theophrastus, *Hist. Plant.*, VII, 1, 6. Compare Pliny, XIX, 35.

¹²⁷ Theophrastus, *Hist. Plant.*, VII, 4, 3; VII, 5, 3.

¹²⁸ Pliny, XVIII, 62; XIX, 41.

¹²⁹ Cato, 40.

similar climatic conditions; for otherwise they are hardly suited to the new region in regard to their time either of sowing or sprouting."¹³⁰ In regard to soil he says: "Seed, like fruit trees, ought to be brought from similar or poorer land, so that the change made is none at all or for the better. However, they maintain that seed sprung from good soil are more vigorous and maintain this virtue for two years. But differences of climate must also be considered. Seed sprung from a sunny, warm region should not be sown in a late chilly region, nor vice versa. The former come out too early and are nipped by the lingering cold; the latter too late, and perish in the heat and drought."¹³¹ Most of these instructions anticipate the modern practice.

The Romans fell heir to the Greek attainments in the art of tillage, and carried the principle of seed selection yet farther. They recognized it as the chief means of keeping a crop true to type. "Seed though long chosen and carefully approved still degenerate unless the largest are selected year after year by the hand of man," says Vergil.¹³² *Siligo*, a choice winter wheat, was broadly planted in the moist alluvium of Italy; but across the Alps it remained constant to type (*pertinax*) only in the fertile soil and mild climate of the middle Rhone and Isere valleys. Elsewhere in Gaul it reverted after two years to the common local variety, unless only the heaviest grains were selected for sowing.¹³³

Large and heavy seed were known to be the best. Moreover these had to be fresh, clean, free from alien admixtures.¹³⁴ Therefore wheat and barley grains which by reason of their weight settled to the bottom of the threshing floor or cleansing sieve were reserved for seed. "This is very necessary because all cereals tend to degenerate." Moreover, only the largest and best ears of wheat and other grains were reserved for seed corn.¹³⁵ "Ears of the finest and best grain should be taken to the threshing

¹³⁰ Theophrastus, *Hist. Plant.*, VIII, 8, 1.

¹³¹ Theophrastus, *Caus. Plant.*, III, 14, 1-2; Pliny, XVIII, 54.

¹³² Vergil, *Georg. I*, 197.

¹³³ Pliny, XVIII, 8.

¹³⁴ Varro, I, 50.

¹³⁵ Columella, II, 9.

floor and kept separate from the rest, so that the farmer may have the best possible seed."¹³⁶ Ears with vacant spaces between the grains were rejected. This is the modern "ear selection." Moreover, the grains themselves were tested by color, outside and in, especially for the red and the white wheat.¹³⁷ There was a special test for lentil seed, which were often eaten by weevils, even in the pod. Therefore after the lentils were threshed they were thrown into tubs of water. The empty or weevil-eaten ones floated, and those which sank to the bottom were dried in the sun and kept for seed.¹³⁸

AMOUNT OF SEED

The amount of seed sown to the *jugerum* varied according to the soil, location, exposure to wind and sun, time of sowing and also according to the kind of seed. A good rich soil could stand heavier seeding than a poor, thin, sandy soil;¹³⁹ for the latter if too thickly sown, yielded a small and empty ear.¹⁴⁰ The average amount broadcast on medium soil was 5 *modii* of wheat, 10 of spelt, and 6 of barley per *jugerum*, or 8, 16 and 10 pecks respectively to the acre.¹⁴¹ These figures correspond fairly well with the modern English practice but exceed the American requirements when the seed are put in with the drill. The ancients themselves recognized that all seed made better growth when set or planted, than when scattered;¹⁴² and hence employed the more careful method in their seed-beds, using fewer to the plot.¹⁴³ As opposed to the average 5 *modii* of wheat per *jugerum*, 4 *modii* sufficed on loose, fertile well-drained land, but 6 *modii* were required for the less productive, dense, cretaceous soil; because a rich soil made the grain stool freely and so yielded a thick crop for a light sowing.¹⁴⁴ The thrifty Mediterranean farmer was

¹³⁶ Varro, I, 52.

¹³⁷ Pliny, XVIII, 54.

¹³⁸ Columella, II, 9.

¹³⁹ Xenophon, *Oeconomicus*, XVII, 8-11; Theophrastus, *Hist. Plant.*, VIII. 6.2.

¹⁴⁰ Pliny, XVIII, 55.

¹⁴¹ Columella, II, 9.

¹⁴² Theophrastus, *Hist. Plant.*, VII, 5, 3.

¹⁴³ *Ibid.*, VII, 4, 3.

¹⁴⁴ Pliny, XVIII, 55.

always ready to save his seed corn; but he knew it was pooreconomy to "rob the harvest" by under-seeding his field on which much labor had been spent.¹⁴⁵ Moreover, the seed was sown thick if put in early in the autumn, because it had to wait some time for the rains before germination and would not stool abundantly; when put in later just in time for the rains, it was sown thinly "to prevent it from being suffocated," because the plants were large and thick.¹⁴⁶

Indirect testimony to the intensive character of ancient Mediterranean tillage is furnished by certain maxims that embodied old agricultural standards. The ideal was the small freehold estate, cultivated with infinite care under the master's personal supervision. The Judean national dream was every man established on a bit of land where he could rest "under his own vine and his own fig-tree," when the day's work was over. "He that hath a little garden and fertilizes it and digs it, and enjoys the produce is far better off than he who works a large garden on shares," was an ancient rabbinical comment on freehold versus tenant farming. Another was a precept for personal supervision: "He that inspects his field daily will find a stater in it."¹⁴⁷ Later Cato paraphrased this motto when he said that on a farm "the master's forehead is of more use than his back."¹⁴⁸ So also Mago of Carthage, who formulated Phoenician tillage practice in the fifth century before Christ, stated that a person buying a farm ought to sell his town house and live in the country.¹⁴⁹

In the Homeric poems, the cultivated estates of princes and kings were of moderate size, though they were supplemented by broad pasture lands which were frequently communal. The reward promised to Meleager by the people of Caledon for a great public service was "a fair demesne of 50 *guai*, the half thereof vineyard and the half open plough-land" located in the fertile Calydonian plain.¹⁵⁰ The garden of Alcinous in the little island

¹⁴⁵ Cato, 5.

¹⁴⁶ Pliny, XVIII, 54.

¹⁴⁷ Article on agriculture in *Jewish Encyclopedia*.

¹⁴⁸ Cato, 4.

¹⁴⁹ Mago quoted in Pliny, XVIII, 7.

¹⁵⁰ *Iliad.*, IX, 578-581.

kingdom of Scheria comprised four *guai*, laid out in vineyard, orchard, and vegetable plots.¹⁵¹ The question is the size of the *gues*, which apparently corresponded to the yoke of the Hebrews and the *jugerum* of the Romans, or the area ploughed by a single yoke of oxen in one day or rather half a day. It has been variously estimated as approximately half an acre by Seymour¹⁵² and as four-fifths of an acre by Ridgway;¹⁵³ but Seebohm would cut the latter estimate in half.¹⁵⁴ Hence the garden of a great king comprised only two acres, and Meleager's estate measured from 20 to 40 acres, in a time when Greece was sparsely populated. The peasant holdings in Boeotia in the eighth century B.C. were apparently very small, because Hesiod wanted only one son, that he might inherit the entire farm.

The scale of land holdings in Attica under Solon (594 B.C.) corresponds with that of the legendary period in general.¹⁵⁵ (I) The great land owner, judging from the yield of his farm, had 75 to 125 acres of grain land, or 20 to 25 acres of vineyard, or 50 to 75 acres of mixed lands. (II) The Knights forming the second class of big proprietors owned 45 to 75 acres of grain land, or 12 to 15 acres of vineyard, or 30 to 45 acres of mixed lands. (III) The Zeugites or medium proprietors owned 30 to 50 acres of crop land, allowing for the alternate years of fallow, or 7 to 10 acres of vineyard, or 25 acres of mixed lands. (IV) The Thetes had 22 acres at most if he raised grain, or 6 acres of vineyard, or 15 acres at most if he carried on mixed farming.¹⁵⁶ Thus the maximum estate in Attica was small, when the people were groaning over the appropriation of the land by the plutocrats. A century and a half later the sub-division of farm land had progressed. The paternal inheritance of Alcibiades was only 300 plethra or 70 acres, though he was accounted rich. The recorded sales of estates indicate many small plots or dwarf farms under 14 acres. The few large holdings were located on the frontier

¹⁵¹ *Odyssey*, VII, 113.

¹⁵² T. D. Seymour, *Life in the Homeric Age* (New York, 1907), 245-246.

¹⁵³ W. Ridgway, *Journal of Hellenic Studies*, VI (1885), 321-326.

¹⁵⁴ F. Seebohm, *Customary Acres* (London, 1914), 194-202.

¹⁵⁵ Plutarch, *Solon*, XVIII.

¹⁵⁶ G. Glotz, *Ancient Greece at Work* (New York, 1926), 247.

remote from Athens or in the mountains where the land was rough and fit only for forest.¹⁵⁷ One such, which became involved in a lawsuit in the time of Demosthenes, is the largest reported, and comprised about 778 acres. It had about 300 acres in barley and 50 acres in vineyards, but it also drew a large revenue from the wood carried daily to the city by six asses.¹⁵⁸ Public opinion opposed the concentration of real estate, as indicated by Plato in his *Laws*, where the maximum property should not contain more than four single lots.¹⁵⁹

It was on these small farms that the Attic farmers practised agriculture as Theophrastus observed it. The pressure of poor soil and meagre rainfall is revealed in the intensive methods there developed. Add to this the pressure of a dense urban population engaged in trade and industries, and relying on the local farmers for fresh vegetables, fruits and flowers, even though most of the breadstuffs came from overseas. Similar conditions held in various other parts of Greece and in the Aegean Islands, with similar effects upon land holdings¹⁶⁰ and tillage methods.

In contrast to Greece and Palestine, ancient Egypt at the zenith of its power doubtless approximated the arable area of 12,000 square miles which the country commands today. Land tenure on a big scale prevailed, owing both to the geographic conditions of ample fertile soil and abundant water for irrigation, and even more to the social organization of the state. But the very fecundity of the Nile Valley induced a density of population which became excessive and therefore enforced careful tillage, especially the extension of the irrigable area, against periods of famine in years of "low Nile."

In Italy again, where typical Mediterranean conditions of climate and relief prevail, tillage adjustment is apparent in the small freehold farms which were the rule, so long as the Roman

¹⁵⁷ A. Boeckh, *Public Economy of the Athenians* (trans. from the German, Boston, 1857), 88-91.

¹⁵⁸ Demosthenes, *Oration against Phaenippus* (trans. by C. R. Kennedy, Bohn Library, 1901), IV, 290-303.

¹⁵⁹ Plato, *Laws*, V, 13.

¹⁶⁰ H. Blümner, *Life of the Ancient Greeks* (trans. from the German, London, 1895), 493.

territory was small. Prior to the Second Punic War, the land allotments of the free peasants were variously two, three, seven, ten, and fourteen *jugera* of tillage land with the right of pasturing cattle on the public domain. Cincinnatus was ploughing his four-*jugera* estate on the Vatican Hill, when called to be dictator in 458 B.C. A farm of seven *jugera* or four and a half acres was considered ample for an industrious peasant by conservative Romans.¹⁶¹ This was the plebeian allotment in the early Republic and it was confirmed by the Consul Curius Dentatus in 289 B.C.¹⁶² It corresponds to the "four acres and a cow" warranted by rural enthusiasts to support the modern farmer, if he practises scientific agriculture and locates near a big urban market.

The small farm, cultivated with intelligence and industry, remained the agricultural ideal of the Romans long after rapid territorial expansion and protracted military service had undermined the little peasant freehold in old peninsular Italy. Colonial allotments did not exceed ten *jugera* or six and a quarter acres till the time of Tiberius Gracchus (133 B.C.), except in Latin colonies planted on remote, exposed frontiers. In such cases larger land grants compensated the settlers for the danger incurred. Bononia was founded as a fortified colony in 189 B.C., among the recently conquered Boii, to guard the only direct road across the Apennines by the Futa Pass, maintaining connections between Rome and the Po Valley. Hence the infantry received 50 *jugera* or 31 acres each, and the cavalry 70 *jugera* or 43 acres.¹⁶³ Similar large allotments were made at other danger points, like Aquileia at the foot of ominous Carso,¹⁶⁴ and Luna which was meant to police the Ligurian raids from the Apennines.¹⁶⁵

The agrarian law of Gracchus provided land grants of 30 *jugera* or 18.7 acres for about 80,000 Roman citizens, and thus inaugurated a larger scale of land holding for the masses. August Meitzen, on the basis of all colonial allotments in ancient Italy,

¹⁶¹ Livy, *Historia*, V, 30.

¹⁶² Valerius Maximus, IV, chap. iv, 6-7.

¹⁶³ Livy, XXXVII, 57.

¹⁶⁴ Livy, XL, 34.

¹⁶⁵ Livy, XXXIX, 1, 2; XL, 38, 41.

concludes that Roman citizens with full privileges held estates of 30 to 70 *jugera* or 18 to 44 acres, and that plebeian farms ran from 7 to 20 *jugera* or 4.5 to 12.5 acres.¹⁶⁶ These were probably the general conditions familiar to Cato, though as a big landed proprietor of this century (died 149 B.C.) he considered a 100 *jugera* vineyard (62 acres) and a 240 *jugera* olive grove (150 acres) a reasonable estate.¹⁶⁷

Yet the little peasant farm tended to revive on fertile soil in populous districts, where careful garden and fruit culture would give the proprietor a living. When a distribution of the public land about Capua and the Stellas Plain in Campania was contemplated in 59 B.C., Cicero said the land could not support more than 5000 colonists, "so as to give them 10 *jugera* apiece,"¹⁶⁸ as if that amount would suffice. On this area of 50,000 *jugera* some 20,000 citizens were settled later, according to Suetonius. Figures like these, compared with colonial grants in modern Africa and the Americas, illuminate the whole question of agricultural methods and arable area in the Mediterranean lands.

All efforts to check the decay of tillage in Roman Italy stressed the old standards of intensive cultivation. "Praise big estates but cultivate a small one" was Vergil's advice.¹⁶⁹ Pliny quotes the ancient adage that it was wiser to sow less and plough more.¹⁷⁰ Columella applied the Greek maxim of "measure in all things" to land holdings, as he enunciated the economic principle that a large farm poorly cultivated yielded less profit than a small one well tilled; and he fortified his opinion by a precept of Mago of Carthage, that a husbandman ought to be more than a match for his farm, so that when he grappled with its problems he should come out ahead in the encounter.¹⁷¹

Nature gave the ancient farmer the privilege of the struggle. Under the influences of climate and relief was evolved a system of tillage, which produced: (I) Winter grain crops maturing in

¹⁶⁶ August Meitzen, *Siedelung und Agrarwesen* (Berlin, 1895), I, 255.

¹⁶⁷ Cato, 2 and 10.

¹⁶⁸ Cicero, *Litterae ad Atticum*, A. II, 16.

¹⁶⁹ Vergil, *Georg. II*, 412.

¹⁷⁰ Pliny, XVIII, 7.

¹⁷¹ Columella, I, 3.

spring or early summer. (II) Planted crops of olives, figs and grapes ripening in autumn without artificial watering. (III) Widely distributed summer crops of fruits, vegetables and fodder plants raised by irrigation, wherever springs and perennial streams were available. The immediate material gain of this triple system was a larger and more certain total harvest and a more varied food supply than the single seasonal cultivation could have yielded. More important, however, was the economic gain, because it meant improved economic methods. It involved increased application of capital for seed, manures and the construction of irrigation canals; and it demanded an elaborate and sustained system of farm work, in consequence of which the labor power of the community was kept employed all the year round.

The economy of national wealth and the gain in national efficiency were incalculable. There was no economic leakage incident to supporting the rural labor in idleness during half the agricultural year; for Mediterranean conditions of climate and relief rendered possible a vegetative year of twelve months. Therefore Varro and Xenophon show the ancient farmer with his slaves hurrying from one urgent agricultural task to another.¹⁷² Harvest followed fast upon harvest all through summer from April to October; and the October harvest crowded upon the heels of the autumn ploughing and sowing. The days of plenty predicted by the prophet Amos, "when the ploughman shall overtake the reaper and the treader of grapes him that soweth seed,"¹⁷³ describes the ideal of productive activity in farm life, not only in Palestine but in other Mediterranean countries. Thus under the prick of Nature's goad, primitive society in these lands began early to develop a capacity for sustained labor, which was at once evidence and guarantee of rapidly advancing civilization.

¹⁷² Varro, I, 29-36.

¹⁷³ Amos, IX, 13.

NEWS NOTES AND COMMENTS

THE AGRICULTURAL HISTORY SOCIETY

In the last number of *Agricultural History* it was announced that Joseph Schafer had been elected president of the Agricultural History Society for the year 1928-29. On account of contemplated absence from the United States during the greater part of the year, Dr. Schafer has declined to serve. Rodney H. True, the retiring president, accordingly appointed a nominating committee consisting of Claribel R. Barnett (chairman), L. C. Gray, and O. C. Stine to submit another name for the presidency. This committee, having mailed ballots to members of the Society, reports the election of Solon J. Buck, secretary of the Minnesota Historical Society.

Mr. Lyman Carrier has recently sent to the Agricultural History Society the second life membership dues which it has received. Maturin L. Delafield of 29 Avenue Davel, Lausanne, Switzerland was the first to do so. Mr. Carrier was active in organizing the Agricultural History Society and has served as its president. He was born and reared on a farm in Michigan. He graduated from Michigan Agricultural College in 1902. He was professor of agronomy at Virginia Polytechnical Institute from 1908 to 1914. He received a M. Agr. degree from Michigan Agricultural College in 1913. During 1914-24 he was an agronomist in the Bureau of Plant Industry in the United States Department of Agriculture. After leaving Washington he engaged in farming near Granger, Indiana. He is now president and general manager of Cocos Seed Incorporated at Coquille, Oregon. Mr. Carrier is the author of *Beginnings of Agriculture in America* (McGraw-Hill Book Company, New York, 1923), an article on Dr. John Mitchell, naturalist, cartographer, and historian, articles

in the *Book of Rural Life* (Bellows-Durham Co., Chicago, 1925), and numerous Virginia agricultural experiment station and United States farmers' bulletins.

PERSONAL

Professor A. O. Craven of the University of Illinois has recently been appointed an associate professor of American history at the University of Chicago. He will continue his researches in agricultural history there.

Mr. Arthur H. Hirsch, professor of American history at Ohio Wesleyan University, read a paper entitled "Efforts of the Grange in the Middle West to Control the Price of Farm Machinery," before the members of the Mississippi Valley Historical Association at Des Moines, Iowa, on April 27, 1928.

The American Historical Association has awarded the Herbert Baxter Adams Prize for 1927 to William F. Galpin for his study, *The Grain Supply of England during the Napoleonic Period*. This volume has been published as one of the University of Michigan publications in history and political science.

Mr. R. J. H. DeLoach, director of the Bureau of Agricultural Research and Economics of Armour & Company of Chicago, and Professor Hooper of the University of Georgia have prepared the writings of Cato and Varro containing materials on agriculture for publication in the Loeb Classical Library. Professor Hooper has done the technical work on the text and the translation. Mr. DeLoach has supplied the introductions and the notes. They plan to include all the Latin agricultural writers in the series. The second volume will contain the writings of Columella and Palladius.

William Abbott Oldfather, professor of classics in the University of Illinois, has completed a bibliography of over 3100 references to agriculture and economics in the literature of the ancients.

MANUSCRIPT MATERIALS

The farm and business records of Levi and Le Roy Davis of the Genesee Valley covering the period 1835-1884 are among the papers recently acquired by the Division of Manuscripts in the Library of Congress.

A movement has been started in North Carolina that is worth watching. Under the direction of Dr. J. G. de Roulhac Hamilton, professor of history at the University of North Carolina, the garrets of the old houses throughout the State are to be thoroughly ransacked for letters and historical material throwing light on the history of the South. The legislature of North Carolina has appropriated funds for a fireproof structure and repository for data at Chapel Hill. The results thus far achieved are most encouraging. It is estimated that the North Carolina material already gathered contains 40,000 pamphlets and volumes relating to early days in Virginia, North and South Carolina, Tennessee and Georgia. The plans include cataloging the material as it arrives and making it available to students. Plans are being considered providing for sending investigators into adjoining States in a house to house canvas for historical data.

COMMENTS ON BOOKS AND ARTICLES

"A Hundred Years of Agriculture," by Arthur Capper, United States Senator from Kansas, is the title of one of the thirty-two articles in *A Century of Industrial Progress* (published for the American Institute of the City of New York by Doubleday, Doran & Company, 1928). The articles have been edited by Frederick William Wile; the book's foreword is by Herbert Hoover.

"The Plough," by B. A. Keen and published in *Science Progress* for April, is an interesting study of the history of the plow. In a concluding paragraph the statement is made that "there are signs that the age-long dominance of the plough in the art of soil cultivation is to be seriously challenged" as a result of developments incident to the perfection of the internal combustion engine.

Editorials which include biographical sketches on two prominent agricultural leaders of the United States who have recently died, namely "Isaac Phillips Roberts, Prophet of Agriculture" and "Willet Martin Hays, A Threefold Pioneer," appear in the *Experiment Station Record* for June. Mr. Roberts was a professor at Cornell University for nearly thirty years and the author of several widely read books on agriculture. Mr. Hays, for many years a professor at the University of Minnesota, served as Assistant Secretary of Agriculture from 1905 to 1913. His interests were in the breeding of improved plants and animals, farm management, and agricultural education.

A chapter on agricultural extension work and another on highways in Austin F. Macdonald's *Federal Aid a Study of the American Subsidy System* (Thomas Y. Crowell Company, New York, 1928) may prove of interest to many workers in the history of American agriculture. This study was made possible by a grant from the Social Science Research Council for "a comprehensive field study of the grants made by the federal government to the states."

The occasion of the celebration of the semi-centennial of the North Carolina Experiment Station observed on April 19, 1928, was the basis of an editorial in the *Experiment Station Record* for July which gives an excellent survey of the leading events which led to and paved the way for experiment stations in this country. Connecticut took the initial step in 1875 and two years later North Carolina followed with the action commemorated by the recent celebration.

Part one of "The Development of American Horticultural Literature, chiefly between 1800 and 1850" appears in the July issue of the *National Horticultural Magazine*. The article is to be continued in later issues. Its author, Hamilton P. Traub, is chief of the Division of Horticulture at the Texas Experiment Station.

"Shall Our Farmers Become Peasants," by William E. Dodd, professor of American history in the University of Chicago, appeared in the May number of *The Century Magazine*. It gives an interesting analysis of the periods of distress and prosperity of American farmers and the relations of agriculture and industry in the United States since the American Revolution.

"The Equine F. F. V's" is the title of an article in the *Virginia Magazine of History and Biography* for October, 1927. It is a study of the evidence for the English horses imported into pre-Revolutionary Virginia.

"The Grain Trade of Alexandria, Virginia, 1801-1815," by W. F. Galpin, was published in the *North Carolina Historical Review* for October, 1927.

"Slaveholding in North Carolina: an Economic View," by Rosser Howard Taylor, has been published as volume xviii of the James Sprunt Historical Studies. It is a doctoral dissertation completed at the University of Michigan.

"Some Effects of the Plantation System upon the anti-bellum South," by W. M. Brewer, appeared in the *Georgia Historical Quarterly* for September, 1927.

"Planters' Wants in the Days of the Confederacy," by E. Merton Coulter, professor of American history at the University of Georgia, appeared in the March number of the *Georgia Historical Quarterly*.

A historical study of two plantations and a county of ante-bellum Georgia by Ralph B. Flanders is printed in the same number. This specialized study is on Houston County and the Tooke and Everett Plantations.

Populism in Alabama, by J. B. Clark and published by the Auburn Printing Company, Auburn, Alabama, in 1927, is a thesis completed at New York University.

"Minor Empresario Contracts for the Colonization of Texas, 1825-1834," by Mary Virginia Henderson, is continued in the July number of the *Southwestern Historical Quarterly*. These documents are a contribution to an understanding of the system of land holding used in colonial Texas. The number also continues Harley True Burton's "A History of the J A Ranch."

"Ranching on the Cheyenne-Arapaho Reservation" by E. E. Dale, appears in the March number of the *Chronicles of Oklahoma*. Mr. Dale is head of the history department of the University of Oklahoma.

An essay on "The Development of the Colorado Cattle Industry," by Robert Rowe, a senior in the Guffey High School, Denver, is published in the *Colorado Magazine* for June. The essay was awarded fourth prize in the magazine's Historical Essay Contest.

Recent issues of the *Missouri Historical Review* have contained several articles of interest to readers of *Agricultural History*. The October, 1927, number has an article by S. M. Jordan, entitled "Farming as it used to be, and as it is in Missouri." The April number includes an article on Dan Carpenter, Pioneer Merchant and Horticulturist, by David W. May, director of the Porto Rico Agricultural Experiment Station. This study gives a picture of the highest type of settler, a man who led his community in practical and cultural matters. It also presents an exceptional view of the appearance of a western Missouri pioneer town. The April number also includes an article, "Pioneer Days in Northwest Missouri—Harrison County, 1837-1873," by Ethel Grant Inman. This article, a revision and condensation of a master's thesis completed at the State University of Iowa in 1927, gives specific attention to the development of agriculture in Harrison County during the years covered by the study.

"The Cleavage Within the Farmers' Alliance Movement" is the title of an interesting study by Herman Clarence Nixon which

appears in the June number of the *Mississippi Valley Historical Review*. At present Mr. Nixon is an assistant professor of history at Vanderbilt University. In the autumn he will go to Tulane University as an associate professor.

A second instalment of "The Economic History of Beef Cattle Production in Iowa," by John A. Hopkins, Jr., appears in the *Iowa Journal of History and Politics* for April. The article will be concluded in the July number.

"Getting the Corn in the Ground," by Glen A. Blackburn in *Wallaces' Farmer* for May 4, 1928, is a popular history of the methods which have been used in the Corn Belt of America during the last seventy-five years.

"Wisconsin Indians in Farming," by J. F. Wojta, is printed in the *Wisconsin Archaeologist* for September, 1927. The article gives a résumé of what has been done in the way of giving the Indians in Wisconsin help in bettering their farming methods. Members of the Menominee Tribe started the movement by making a request of the Agricultural Extension Service in 1914. The author is a county agent leader in Wisconsin.

"Annals of a Wisconsin Thresherman," an article by A. K. Main explaining the methods and costs of threshing in the 80's, is in the *Wisconsin Magazine of History* for March.

Grain Growers' Cooperation in Western Canada, 1900-1927, by Harold S. Patton, now at the University of Cincinnati, has recently been published by the Harvard University Press as a volume of the Harvard Economic Studies. Appendix I is an extensive list of "Sources and References" on the subject.

Dr. Robert Shirra Gibb's *A Farmer's Forty Years in Lauderdale* (Oliver and Boyd, Edinburgh, 1927) contains interesting and valuable recollections, chiefly on the author's nearly half a century of farming life in the Borders. Dr. Gibb was trained in science;

he was a keen observer and a successful experimenter in farming methods. In the foreword, Sir Robert Greig, chairman of the Board of Agriculture for Scotland, states that Dr. Gibb "served on every public body of any importance concerned with the promotion of Scottish agriculture, and was a member of various local authorities," and that he took part in agricultural commissions to Ireland, Denmark, Canada, and Australia. Sir Robert Greig predicts that "in due time this book will find its rightful place in the book-shelf of the countrymen, side by side with that great farming classic, *The Chronicles of a Clay Farm*."

In *The Evolution of the English Farm* (Harvard University Press, Cambridge, 1927), Mrs. M. E. Seeböhm has tried to explain "how this most primitive of institutions—the farm—one so fundamentally important to the existence of the human race, was developed." Her study begins with "the little dark Neolithic farmer, laboriously chipping his way through life with a sharpened flint" and continues through the Bronze, Early Iron, Roman, Saxon, Norman, and later ages of English history. For each of these periods, the farm buildings, the livestock, the crops, the methods of tillage, the implements, the division of labor, and the dress, food, and drink of the farmers are described. Besides the systematic treatment of these topics, many other details are included. Seventy illustrations add much to this study.

"Agricultural Observations of Bernard Palissy, the Huguenot Potter" by Grace M. Ziegler appeared in the *Scientific Monthly* for January. Miss Ziegler is a member of the Department of Agriculture at Trenton, New Jersey.

"Agricultural Magic," by the same author, is included in the July number of the *Scientific Monthly*.

Among the Danes, by Edgar Wallace Knight, as part of the results of a study of certain types of schools and education in Scandinavia undertaken while a research fellow of the Social Science Research Council, has recently been published by the

University of North Carolina Press, Chapel Hill, 1927. This book, dealing chiefly with education in Denmark, is virtually a chapter in the history of agricultural Denmark. The folk high school receives particular consideration.

A second edition of *El Problema Agrario de Mexico* by Lucio Mendieta y Núñez has recently been published. This book gives an account of agriculture during the precolonial and colonial epochs. The problems and development of agriculture during the national period are also considered in detail. The introduction is by Manuel Gamio.

MEMBERS ADDED SINCE MAY, 1928

- BALMER, F. E., County Agent Leader, University Farm, St. Paul, Minn.
BEACH, WALTER S., Truck Experiment Station, Bustleton, Philadelphia, Pa.
BLACK, JOHN D., Widener Library W I, Harvard University, Cambridge, Mass.
CLAYPOOL, JOHN H., 49 Marvin Avenue, Hempstead, L. I., New York.
GAY, EDWIN F., Department of Economics, Harvard University, Cambridge, Mass.
GRIFFITH, ALBERT W., Ripon College, Box 37, Fisk, Wisconsin.
GUARD, SAMUEL R., Editor, Breeder's Gazette, Chicago, Ill.
JENKINS, ARTHUR H., Editor, The Farm Journal, Washington Square, Philadelphia, Pa.
MERK, FREDERICK, Widener Library 181, Harvard University, Cambridge, Mass.
PAULSON, W. E., Farm Management, Purdue University, Lafayette, Ind.
PECK, MILLARD, Bureau of Agricultural Economics, U. S. Department of Agriculture, Washington, D. C.
TAYLOR, CARL C., Dean, North Carolina State College of Agriculture and Engineering, Raleigh, N. C.
WALSTER, H. L., Dean, North Dakota Agricultural College, Fargo, N. Dak.
WEHRWEIN, GEORGE S., Agricultural Economics, College of Agriculture, Madison, Wis.

Libraries

- Adelbert College Library, Cleveland, Ohio.
Library Branch, California College of Agriculture, Davis, California.
General Library, University of Chicago, Chicago, Ill.
Library, Kansas Agricultural College, Manhattan, Kansas.
Library, Oregon State Agricultural College, Corvallis, Oregon.
Library, University of Washington, Seattle, Wash.